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TREATMENT OF WRITTEN DISCOURSE AFTER TRAUMATIC BRAIN INJURY

BY

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Treatment of Written Discourse after Traumatic Brain Injury

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Abstract

Traumatic brain injury often leads to cognitive communication disorders, commonly disorders of written discourse. Research in the field of written discourse after traumatic brain injury does not provide a strong protocol for improvement of functional written skills. The aim of this study was to create an effective treatment plan to address written discourse impairments in two college students from Eastern Illinois University with traumatic brain injury (TBI). Individualized treatment plans were developed for participants based on the need for improvement in productivity, efficiency, and coherence (both global and local) in written discourse. Treatment was developed based on individual needs and focused on reducing executive functioning, working memory, and selective attention demands. Productivity was treated by creating outlines to reduce cognitive demands and organize topics for each writing sample. Efficiency improvements were targeted by prompting the participants to self-judge the conciseness of each sentence. Coherence was treated by requiring participants to self-assess the connectedness of the sentences to the topic and to each other. Results are discussed.

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CHAPTER I

Introduction

Traumatic brain injury (TBI) often leads to cognitive communication disorders, and, more specifically, disorders of written discourse. The incidence of TBI occurs more frequently between 15 and 24 years, which are the core years for professional writing development. It is imperative for high school and college students to have adequate writing skills to be academically successful.

Previous research has indicated several areas of written discourse that are impaired after TBI. Productivity, efficiency, and global and local coherence are typical areas of written discourse that are affected after TBI. Wilson and Proctor (2000) found that oral and written productivity, the number of ideas required to express a concept, differed between adolescents with closed head injury (CHI) and controls. Written efficiency, the number of words used to express an idea, was also measured by Wilson and Proctor (2000). Coherence was evaluated using two measures: global and local. Global coherence was defined as the relationship between individual ideas and the topic of the narrative. Local coherence was defined as the relationship between a single idea and the ideas that preceded or followed. In Wilson and Proctor, differences for local coherence were found in participants with CHI, as they did not link successive ideas. Davis and Coelho (2004) studied oral storytelling and story retelling in adults with TBI. Results indicated deficits in local coherence and accuracy of ideas.

Executive functioning and working memory are two areas of cognitive functioning that have been linked to discourse skills. TBI often leads to reduced executive functioning and working memory, which are related to the changes in oral and written discourse. Proctor, Wilson, Sanchez, and Wesley (2000) found that there was a positive relationship between executive

functioning and working memory in a group of adolescents with CHI and matched controls. Goal setting, planning, sequencing, awareness of deficits, and self-monitoring (all executive functioning tasks) were associated with working memory abilities. Participants with CHI had significantly lower working memory scores than did controls. Executive functioning was different between the two groups, as the experimental group was not as successful in higher functioning skills, especially as severity of injury increased (Proctor et al., 2000).

Youse and Coelho (2005) studied the relationship between working memory and oral narratives in 55 participants with TBI between 16- and 65-years. Analysis showed that abilities in working memory were related to the efficiency in story retelling and story generation. Specifically in story retelling, decreased abilities in working memory paralleled severity of deficits in efficiency, coherence, and productivity (Youse & Coelho, 2005). Hay and Moran (2005) found similar results when studying nine participants with TBI between 9 years, 5 months and 15 years, 3 months. Participants listened to an audiotaped fable and were required to regenerate the story. Narratives were analyzed for organization and global components. Results indicated a strong, positive correlation between working memory and productivity and coherence (Hay & Moran).

Students who have sustained a TBI are at a disadvantage in academic writing, especially because there is not sufficient research on written discourse therapy protocols. Youse and Coelho (2009) developed a protocol focused on reducing working memory, selective attention, and executive functioning demands during writing tasks. The targeted skills (productivity, efficiency and coherence) were facilitated by use of an outline and strategies to increase efficiency and coherence. Researchers used the Attention Process Training II program for six to eight weeks. Interpersonal Process Recall was then implemented in therapy for an additional six

to eight weeks to treat discourse using feedback, modeling, coaching, and rehearsal. Of the two participants in the study, one made minor improvements in attention, but the improvements did not affect discourse appropriateness (Youse & Coelho, 2009).

The current study developed a therapy protocol to treat productivity, efficiency, and coherence in the discourse of adolescents with TBI. Therapy focused on increasing demands on working memory and selective attention by developing organizational and topic maintenance skills. The targeted skills (e.g., forming an outline of ideas) were designed with the intent to reduce demands on executive functioning. It was hypothesized that providing participants with an outline and specific verbal feedback would increase productivity, efficiency, and global and local coherence in written discourse in individuals associated with TBI.

CHAPTER II

Literature Review

Treatment of Written Discourse after Traumatic Brain Injury

Each year, approximately 1.7 million people in the United States sustain a traumatic brain injury (TBI), accounting for roughly 275,000 hospitalizations and 52,000 deaths annually (Centers for Disease Control and Prevention [CDC], 2010a). These data most likely underestimate the incidence of TBI, as many cases are not properly diagnosed or go untreated (Horton & Wedding, 2008). TBI is most frequent among males between the ages of 15 and 24. Motor vehicle accidents are the most prevalent etiologies of TBI, but trauma is also common from sporting injuries, missile wounds, and industrial accidents (McDonald, Tougher, & Code, 1999).

The American Speech-Language-Hearing Association (ASHA) defined the roles of a speech-language pathologist (SLP) in treatment of cognitive communication disorders. Primary roles of the SLP include screening, assessment, diagnosis, and treatment of cognitive language disorders. SLPs are responsible for screening individuals and identifying concerns about current or emerging cognitive communication disorders. Appropriate measures of assessment are then conducted and analyzed by the SLP to conclude type and severity of disorder. It is the SLPs responsibility to ensure that several forms of assessment are used to make clinical conclusions and that assessment accommodates the client's cultural background. Treatment plans are then developed and implemented by the SLP based on clinical expertise, family and client feedback, and evidence-based practice (American Speech-Language Hearing Association, 2005).

Classification of Traumatic Brain Injury

The two most basic classifications of TBI are closed and open. A diagnosis of closed TBI indicates that the skull and dura remain undamaged. Conversely, an open TBI specifies that the skull is fractured which may lead to penetration of the brain by foreign objects or fragments of bone (McDonald et al., 1999).

The nature of injury to the brain can be differentiated into two types: focal and diffuse. Focal brain injuries indicate injury to a specific area of the brain (Horton & Wedding, 2008). This includes instances where blood vessels located in the brain rupture, leading to numerous and often microscopic cerebral hemorrhages. Focal brain injury can also occur when tissue is lacerated at the site of impact, which usually occurs due to sharp ridges in the skull. This is most common in the lateral parts of the frontal and temporal lobes, as they are adjacent to the anterior and middle fossae (McDonald et al., 1999). Injuries to subcortical regions of the brain are classified as diffuse axonal brain injuries (DAI) (Horton & Wedding, 2008). DAI can occur after a high velocity impact, causing the fibers that compose the cerebral white matter to stretch and rotate (McDonald et al.).

Secondary brain injury is an additional pathological process associated with TBI. After impact, hematomas or cerebral edemas may occur. These can cause additional damage to the brain, or the brain can shift due to an increase in pressure (Horton & Wedding, 2008).

Recovery after Traumatic Brain Injury

Currently, 5.3 million Americans have long-term disabilities as a result of TBI (CDC, 2010b). Several factors contribute to prognosis and recovery. Severity of the TBI is the best indicator for recovery, with more severe injuries having a poorer prognosis. Persisting disabilities from TBI are typically associated with increased severity of injury, but mild to

moderate TBI can also cause lasting effects on personal and professional accomplishments (Horton & Wedding, 2008).

Other factors that contribute to prognosis include age, nature of the injury, quality of immediate care, early intervention, accessibility of appropriate rehabilitation, and social support. Although it is not fully understood how the brain recovers after trauma, scientific evidence shows that the brain's plasticity is a contributing factor. This theory is connected with age, as younger people have more brain plasticity than older people, and younger people tend to improve more and recover faster as long as various skills are already developed. The location of focal injuries serves as another indicator of disabilities that the patient may sustain. These injuries can negatively impact essential daily living skills from language to mobility (Daisley, Tams, Kischka, 2009).

Communication Difficulties after Traumatic Brain Injury

Symptoms of TBI include difficulties with attention, memory, reasoning, sensation, language, and changes in emotion (CDC, 2010b; Keller, 2001). These changes are most often associated with damage to the frontal lobes. The frontal lobes are primarily responsible for problem-solving skills, planning, and initiating and regulating behavior. Hearing, language comprehension, and memory are the dominant functions of the temporal lobes. Damage to either of these areas of the brain can severely affect functioning in daily living (Daisley et al., 2009).

Communication disorders are common among patients with severe TBI; about 75% of patients with a severe TBI have a long-term communication disability. Mild to moderate TBI often lead to communication disorders, including deficits in fluency, word-recall, organization, language comprehension, and verbal reasoning (Horton & Wedding, 2008; McDonald et al.,

1999). These disorders can have a significant impact on the patient's social and professional life (Horton & Wedding).

Factors Associated with Communication Disorders after Traumatic Brain Injury

Leblanc, De Guise, Feyz, and Lamoureux (2006) analyzed factors that contributed to the outcome of language comprehension and expression after TBI. The naming skills, verbal fluency, and auditory comprehension abilities of 348 participants ranging from 15- to 89-years old were evaluated by speech-language pathologists and neuropsychologists. Naming skills were evaluated using *The Boston Naming Test* (Kaplan, Goodglass, Weintraub, 1983) and the *Arizona Battery for Communication Disorders of Dementia* (Bayles & Tomoeda, 1991). Auditory comprehension was analyzed using subtests of *The Boston Diagnostic Aphasia Examination* (Goodglass, Kaplan, & Barresi, 2001) and the *Detroit Test of Learning Aptitude* (Baker & Leland, 1965). The Animal Naming extended subtest from *The Boston Diagnostic Aphasia Examination* (Goodglass et al., 2001) and Word Fluency (FAS) sub-test from the *Neurosensory Center Comprehensive Examination of Aphasia* (Spreen & Benton, 1969) were used to evaluate verbal fluency. Results indicated that level of formal education was one factor that predicted outcome of communication disorders; participants with less education had a greater chance of exhibiting deficits in communication across all domains. Severity of TBI (measured by *Glasgow Coma Scale*—GCS) was also associated with increased incidence of communication disorders. A significant relationship was found between the presence of bilateral or diffuse lesions in areas other than the cerebral cortex and communication disorders—which also affected TBI severity rating levels. Age was another influential factor to language outcomes after injury in participants, as younger people in this study recovered better than older (Leblanc et al., 2006).

Impact of traumatic brain injury on communication. Analysis of the discourse of participants with TBI shows a prevalence of difficulties participating in conversation including impairments in speech outflow and verbal pragmatics (e.g., responding to open-ended questions) (Rousseaux, Vèrigneaux, & Kozlowski, 2010).

A cohort study (Dahlberg et al., 2006) investigated the social skills of 60 individuals at least one year post brain injury (mean average was seven years). Social skills were self-rated, evaluated by significant others, and evaluated by speech-language pathologists. Researchers gave the participants *The Social Communication Skills Questionnaire—Adapted*, *The Craig Handicap Assessment and Reporting Technique—Shortform*, *The Community Integration Questionnaire*, and *The Satisfaction with Life Scale* to evaluate social communication skills (Dahlberg et al., 2006).

Subjects self-identified social communication difficulties in areas such as conversation maintenance, generating new ideas and topics, knowing how and when to end a conversation, changing subjects, thought organization, asking questions, and ability to interrupt others in conversation fluidly. Significant others reported the same difficulties as the participants, as well as 11 additional social communication problems observed in the participants. These additional difficulties included rewording comments, offering clear statements of ideas, defending thoughts with facts, using an aggressive tone of voice over an assertive tone, and controlling emotions. Clinician ratings showed a strong agreement with the ratings of significant others. This suggested that deficits in social communication were noticed by others more than by the patients themselves. Finally, participants with TBI who reported decreased social communication skills also noted less satisfaction with life, indicating that communication greatly impacts the quality of life after injury (Dahlberg et al., 2006).

Rousseaux, Verigneaux, and Kozlowski (2010) recently compared the conversational and executive function skills of patients with TBI to those of a non-injured control group. Communication (e.g., participation and verbal and nonverbal communication), executive functioning, language, and behavior were analyzed in 16 participants who were in the rehabilitation phase of post-injury treatment. A variety of assessments were used, including the *Lille Communication Test*, the *Neurobehavioral Rating Scale-Revised*, the *Stroop* test, *The Trail-Making Test, Categorical Evocation, and the Montreal-Toulouse Protocol for Aphasia Examination* (as cited in Rousseaux et al., 2010). Compared to the control group, the group with TBI showed reduced participation skills, as well as fluency and intelligibility difficulties. No deficits were found in semantics, which agreed with several other studies on communication outcomes after TBI (Rousseaux et al.).

King, Hough, Walker, Rasatter, and Holbert (2006) investigated the differences between lexical recall in ten adult participants between 18- and 45-years of age with TBI and a non-injured control group. The *Test of Adolescent and Adult Word Finding* (German, 1990) and the *Test of Word Finding in Discourse* (German, 1991) were administered to measure lexical recall in both groups. Results indicated little difference in lexical recall between the two groups. The study did uncover distinct differences in latency, as those with TBI took longer to respond than the control group (King et al., 2006).

TBI can cause severe communication problems that can change the patients' life. Communication disorders acquired after TBI impact the patient's daily living, as they are not able to complete the daily tasks that were simple before injury, in part because they cannot communicate effectively.

Discourse after Traumatic Brain Injury

Types of discourse. Communication disorders, specifically impairments in discourse, are prevalent in patients with TBI. Discourse is divided into three categories: conversation, expository discourse, and narrative discourse (of which there are many types). Conversational discourse involves a minimum of two individuals participating in dialogue to advance a discussion through speaking and listening. Expository discourse includes oral or written communication that introduces facts or instruction. Directions, lectures, and procedures on how to do something are all included in expository discourse. Narrative discourse is an oral or written form of communication that sequentially depicts factual or fictional events. Narratives are often used for entertainment and include fictional stories, personal accounts, and explanation of others' accounts (Hughes, McGillivray, Schmidek, 1997).

Analysis of discourse. Discourse is analyzed on four levels, including within-sentence, across-sentence, text-level, and story grammar. Within-sentence analysis includes productivity, which is the amount of communication units (CU) (an independent clause and all of its modifiers) used in discourse, as well as semantic and syntactic complexity. Within-sentence analysis also evaluates for the presence of mazes, an indication of verbal decision making, and efficiency, or the number of words used to express an idea. Across-sentence analysis measures cohesion, which is the relationship between sentences that connect ideas from statement to statement. Text-level analysis evaluates for coherence, which is the overall theme of discourse. Two sub-types of coherence can be analyzed. Local coherence is the thematic relationship between two sentences, while global coherence is the relationship between the subject of a sentence and the theme of the narrative. Story grammar involves the production of over-arching

schemas linking characters and events within a schema in a series of episodes reflecting characters' motivation and the overall purpose of the narrative (Lê, Mozeiko, Coelho, 2011).

Research on normal patterns of discourse. Smith, Heuerman, Wilson, and Proctor (2003) studied 25 neurotypical young adults to determine patterns of discourse. Oral and written narratives were obtained through picture descriptions using the "Cookie Theft Picture" from the *Boston Diagnostic Aphasia Examination* (Goodglass et al., 2001) and the production of a personal narrative about the participant's "most memorable summer" (Smith et al., 2003). Discourse was analyzed for productivity, efficiency, coherence, and gender differences. Results indicated that subjects' speaking and writing were more productive in personal narratives when speaking and writing than in picture description tasks. Participants were more efficient when speaking than writing in both personal narratives and picture descriptions. No significant differences were found for local coherence or global coherence in oral and written elicitations. No differences were found when comparing male and female participants (Smith et al., 2003).

Research on oral and written patterns of discourse after traumatic brain injury. Wilson and Proctor (2000) researched the discourse of eight young adults who were 2-5 years post closed head injury (CHI), all of whom sustained their injuries in a motor vehicle accident. The authors compared results of discourse analysis to those of young adults without CHI. Measures of productivity, efficiency, cohesion, mazes, and coherence were used to compare discourse from each group. Significant differences between the discourse of participants with CHI and participants without CHI were found in oral productivity and local coherence. Participants with CHI used more words when describing a picture and did not link concepts between sentences as well as the control participants (Wilson & Proctor, 2000).

Davis and Coelho (2004) studied eight adult participants with CHI and mild cognitive impairments. It was found that participants had deficits in referential cohesion, logical coherence, and accuracy of narration. Participants with CHI were at least one year post-injury (range between 1-11 years) and had a diagnosis of moderate to severe CHI. Eight non-injured controls were studied using the same measures as the experimental group. To elicit discourse samples, researchers used two sets of cartoon picture sequences. Participants were asked to tell the story that the sequence illustrated (Elicited-A). The researchers then removed the picture sequences and prompted the participants to retell the story without the picture sequence in sight (Elicited-B). Auditory versions of story retelling were then studied by reading two short folktales to the participants and asking them to retell the story. Participants' stories were transcribed into paragraphs and were analyzed for cohesion, coherence, and accuracy (relation of the story's theme and point). Results revealed impairment in cohesiveness in the CHI group for Elicited-A and both auditory-oral story retelling tasks. Coherence was impaired in the participants with CHI in story retelling tasks (except one auditory-oral story), but not elicited tasks. Analysis of the narratives showed that accuracy was impaired in participants with CHI in the elicited conditions, but not in the retelling conditions (Davis & Coelho).

Research on the discourse of neurotypical individuals compared to the discourse of those with TBI showed that there are significant differences between the two groups. The discourse of people with TBI lacks productivity, coherence, and accuracy. This makes effective communication difficult for those with TBI. Leblanc et al. (2006) found evidence that more severe TBIs are associated with increased communication disorders. Reduced participation skills, fluency, and intelligibility were areas of communication that were found to be disordered after TBI by Rousseux et al. (2010). Although King et al. (2006) found little differences in semantic

recall in participants with TBI and controls; it was found that there was a significant increase in recall latency. Surveys answered by speech-language pathologists, adults with TBI, and family members of those with TBI showed several areas of communication deficit including: organization, rewording comments, defending thoughts with facts, and social communication skills. Participants with TBI reported less satisfaction with life due to loss of functioning (Dahlberg et al., 2006). Table 1 represents a summary of studies on communication skills after TBI.

Table 1—Communication Skills after TBI					
Source	***Age Range # of TBI Subjects***	***Elicitation***	***Communication Skill***	***Stimulus***	***Findings***
Leblanc, De Guise, Feyz, & Lamoureux (2006)	-15-89 years -348 participants	Oral	Naming	The *Boston Naming Test*, the *Arizona Battery for Communication Disorders of Dementia*, the *Detroit Test of Learning Aptitude*, *Neurosensory Center Comprehensive Examination of Aphasia*	-Participants with less education had a greater chance of communication deficits across all domains -More severe TBI associated with increased communication disorder -Younger patients recovered better than older
Dahlberg, Hawley, Morey, Newman, Cusick, & Harrison-Felix (2006)	-20-63 years (mean 39) -60 participants	Oral	Conversation maintenance, topic and idea generation, ending a conversation, changing subjects, conversation fluency	The *Social Communication Skills Questionnaire-Adapted*, The *Craig Handicap Assessment and Reporting Technique-Shortform*, The *Community Integration Questionnaire*, and the *Satisfaction with Life Scale*	-Clinician and significant others findings in agreement; difficulties rewording comments, clear statements of ideas, defending thoughts with facts, using aggressive over assertive tones, and controlling emotions -TBI participants with reported decreased social communication skills also noted less satisfaction with life

Rousseux, Vèrigneaux, & Kozlowski (2010)	-18-70 years (mean 32.9) -16 participants	Oral	Communication, executive functioning, language	*Lille Communication Test*, *Neurobehavioral Rating Scale-Revised*, *Stroop Test*, *Trail-Making Test*, categorical evocation, and the *Montreal-Toulouse Protocol for Aphasia Examination*	-Reduced participation skills, fluency and intelligibility difficulties -No deficits found in semantics
King, Hough, Walker, Rasatter, & Holbert (2006)	-18-45 years (mean 28.81) -10 participants	Oral	Lexical Recall	The *Test of Adolescent and Adult Word Finding*, *Test of Word Finding in Discourse*	-Little difference in lexical recall between TBI and control -Latency increase with TBI
Channon & Watts (2003)	-18-60 years -15 adults with CHI -16 matched controls	Oral	Pragmatic judgment and executive functioning, response planning, sentence completion	*Dysexecutive Questionnaire* (DEX), *Telephone Search While Counting Test* from the *Test of Everyday Attention*, *Hayling Test*, *Six Elements Test* from the *Behavioral Assessment of the Dysexecutive Syndrome Battery*	-CHI group impaired in social judgment and non-social executive tasks -Strong relationship between social judgments and inhibition on executive function tasks -Deficits in inhibition can cause difficulty in processing literal and non-literal language, and use of inappropriate/irrelevant statements

Cognitive factors in discourse. Cognitive communication disorders resulting from TBI, including disorders affecting discourse, may be connected to deficits in executive functioning and working memory. Goal setting, planning, self-awareness, initiation, and problem solving abilities are all cognitive aspects of executive functioning. Working memory is a form of memory where information is briefly stored and manipulated for processing. Studies have shown strong relationships between levels of executive functioning and working memory and discourse abilities after TBI (Lê, Mozeiko, & Coelho, 2011).

Smith et al. (2003) studied verbal working memory in healthy adults to determine the effect of normal working memory on discourse. Verbal working memory was measured by administering the *Recognition Memory Subtest of the Goldman-Fristoe-Woodcock Auditory Memory Battery* (Goldman, Fristoe, & Woodcock, 1974). Researchers collected oral and written narratives from participants using the "Cookie Theft Picture" from the *Boston Diagnostic Aphasia Examination* (Goodglass et al., 2001) and by collecting a personal narrative about the participants' "most memorable summer" (Smith et al., 2003). Discourse measures included productivity and efficiency and were correlated with the results from the verbal working memory test. There was no significant correlation between productivity and efficiency of discourse and verbal working memory in normal adolescents (Smith et al., 2003).

Proctor, Wilson, Sanchez, and Wesley (2000) studied the relationship between executive functioning and working memory in adolescents who had sustained closed head injury (CHI). Participants included eight adolescents with CHI and eight non-injured controls matched for age, socioeconomic status, and gender. Participants ranged from 15- to 22-years old. Participants ranged between 6-months and 5-years post-injury at the time of the study. Four participants were diagnosed with borderline CHI, two participants had a diagnosis of mild CHI,

one individual was diagnosed with mild CHI, and one participant had a diagnosis of severe CHI (Proctor et al.).

Levels of cognitive impairment in participants with CHI were evaluated using the *Scales of Cognitive Ability for Traumatic Brain Injury* (SCATBI) (Adamovich & Henderson, 1992). Results from the SCATBI indicated four participants with borderline cognitive skills, two participants with mild levels of cognitive impairment, one participant with moderate impairment, and one participant with a rating of severe impairment. Participants' executive functioning was assessed by administering the *Profile of Executive Functioning* (Pro-Ex) (Braswell et al., 1992), which provided ratings of goal selection, planning and sequencing, initiation, execution, time sense, awareness of deficits, and self-monitoring. Participants' verbal working memory was evaluated using the *Recognition Memory Test* (RMT) (Goldman et al., 1994) (Proctor et al., 2000).

Analysis of mean scores from the Pro-Ex revealed that participants with CHI were rated significantly different from the control group. Analysis of the mean scores from the RMT did not significantly differentiate between the experimental group and the control group. Each group's performance on the Pro-Ex and SCATBI was correlated with performance on the RMT, with results showing a significant relationship between executive functioning and working memory for the participants with CHI. Specifically, strong positive correlations were found between goal setting, planning and sequencing, awareness of deficits, and self-monitoring ratings on the Pro-Ex and performance on the RMT. Analysis of scores on the SCATBI and RMT showed that participants who scored as mild, moderate, and severe on the SCATBI performed statistically less well on the RMT and Pro-Ex than the participants with a borderline severity rating. This

showed that as severity of cognitive linguistic deficit increased, it was likely that deficits in working memory and executive functioning also increased (Proctor et al., 2000).

Youse and Coelho (2005) studied the relationship between working memory and oral narrative discourse in 55 adolescents and adults with a closed head injury. Participants ranged in age from 16 years to 69 years old, and time after injury ranged from one to 99 months. Story retelling and story generation samples were taken to analyze oral narrative discourse. Story retelling samples from participants were elicited through a 19-picture story presented on a filmstrip. After participants viewed the picture story, they were instructed by a researcher to describe what happened in the story. Story generation samples from participants were collected by presenting participants with a Norman Rockwell painting. Researchers instructed participants to tell a story explaining what was happening in the picture. Samples were taken by transcribing the participants' descriptions and separating narratives into T-units (independent clauses with corresponding dependent clauses) (Youse & Coelho).

Narrative data were measured at the within-sentence level and the between-sentence level. Within-sentence measures included the number of words per T-unit and number of dependent clauses per T-unit. Between-sentence measures look at cohesion and grammar. Working memory was measured using three subtests from the *Wechsler Memory Scale* (WMS): Digit Span, Logical Memory, and Associative Learning (Wechsler, 1945) (Youse & Coelho, 2005).

Results were measured by Pearson correlation coefficients between the discourse measures and the WMS scores. Results showed a modest significant relationship between working memory scores on the WMS and cohesiveness and efficiency in story retelling and story generation narratives. Results from story retelling analysis indicated modest positive

correlations between working memory (WMS associate learning subtest) and number of words per T-unit, number of subordinate clauses per T-unit, number of complete ties out of total ties (cohesiveness), and number of total episodes. Results from story generation analysis indicated a modest positive correlation between working memory (WMS digit span subtest) and number of subordinate clauses per T-unit (Youse & Coelho, 2005).

Wilson and Proctor (2000) analyzed the oral and written discourse of eight young adults with CHI who were 2- to 5-years post injury, and a group of eight controls. The authors also measured participants' executive functioning and working memory skills. Executive functioning skills were measured using the *Profile of Executive Control System* (Braswell, et al., 1992) and working memory was measured using the "Recognition Memory" subtest of the *Goldman-Fristoe-Woodcock Auditory Skills Test Battery* (Goldman, et al., 1974). In oral discourse, local coherence and productivity were the only measures of discourse that were significantly different between participants with CHI and the control group. Written discourse results were unique in that written productivity, efficiency, and lexical cohesion scores were related to individual executive functioning and working memory skills regardless of group membership (CHI or control) (Wilson & Proctor).

Channon and Watts (2003) studied 15 adults with CHI and 16 age, gender, education, and IQ matched control participants to identify any relationship between pragmatic judgment and executive functioning. Participants completed the 20-item *Dysexecutive Questionnaire* (DEX) from the Behavioral Assessment of the Dysexecutive Syndrome (BADS) (Wilson, Alderman, Burgess, Emisle, & Evans, 1996). Social judgment was assessed by presenting participants with 12 written conversations. Each conversation contained a social context description along with the dialogue of a two-person conversation. Participants were to categorize the social interactions as

"appropriate," "middle," or "inappropriate." Non-social executive functioning was evaluated by measuring working memory, inhibition, and multitasking. Working memory was measured with the *Telephone Search While Counting* (TSWC) subtest from the *Test of Everyday Attention* (TEA) (Robertson, Ward, Ridgeway, & Nimmo-Smith, 1994). The *Hayling Test* (Burgess & Shallice, 1996), which primarily evaluates the ability to inhibit the use of meaningful words and instead, generate nonsensical words to complete sentences, was used to measure inhibition. Participants' ability to organize, plan, and execute multiple tasks in a timed-situation was assessed using the *Six Elements* subtest from the BADS. This test analyzed the organization and planning of the participants' responses. When compared to the control group, the participants with CHI displayed impairments in both social judgment and non-social executive tasks. Regression analysis of the data found a strong relationship between social judgments and inhibition on executive function tasks. Researchers concluded that deficits in inhibition may lead to difficulty in processing literal and non-literal language and the use of inappropriate or irrelevant statements (Channon & Watts).

Hay and Moran (2005) compared expository and narrative retelling abilities with working memory in 18 children, nine with CHI and nine non-injured controls who were matched for age, gender, and education. Each participant completed two working memory tests—the *Nonword Repetition Test* (Dollaghan & Campbell, 1998) and the *Competing Language Processing Task* (Gaulin & Campbell, 1994). To assess narrative discourse, researchers played a tape of a fable. The tape was played twice to ensure maximum understanding. Participants were then asked to retell the story and to state a moral or lesson that could be learned from the fable. Expository discourse was assessed by playing a tape of two procedural discourse passages explaining how to play a game. Participants were then asked to describe how to play the game and the aim of the

game. Analysis of discourse included language domains and information domains. Language domains included: number of different words, number of t-units, and sentence complexity. Information domains included: number of prepositions expressed, completeness of episodic structure, and intactness of global story content.

Results indicated that working memory was positively correlated with narrative retelling and expository skills as measured by number of different words, number of T-units, number of propositions, episodic structure, and number of global components. Children with CHI displayed overall deficits in expository and retelling discourse compared to the non-injured control group. Both groups found it easier to devise an aim for expository discourse than to think of a moral or lesson from the fables in the narrative discourse test. Correlational analysis showed a relationship between working memory and language and information domains in both discourse tasks. Although no significant correlation was found between working memory and the ability to describe moral concepts, the authors suggested that working memory is an important part of the moral reasoning process. Formulating statements to explain morals requires working memory and executive functioning because a moral from a story requires knowledge from past experiences, inference, reasoning, and memory of information presented in the story. Scores obtained from both tests revealed that working memory had a strong positive association with language measures including number of different words, number of T-units, number of propositions, episodic structure, and number of global components (Hay & Moran, 2009).

Empirical evidence shows strong relationships between executive functioning, working memory, and communication skills. Studies on the discourse skills of people with TBI reveal associations between executive functioning and working memory and oral and written discourse. Level of working executive functioning and working memory impairments affected specific

types of discourse such as expository discourse, story retelling tasks, and measures including productivity, efficiency, and lexical cohesion. Smith et al. (2003) found that there were no significant correlations between productivity and efficiency of discourse and verbal working memory. However, Wilson et al. (2000) found that written productivity, efficiency, and coherence were related to level of executive functioning and level of working memory in participants with CHI. Proctor et al. (2000) supported Wilson et al. (2000) in finding that skills in working memory and executive functioning were connected in participants with CHI and in controls. Participants with mild, moderate, and severe CHI had significantly more impaired executive functioning and working memory skills, showing a relationship between severity and loss of cognitive functioning (Proctor et al.). Youse and Coelho (2005) found significant correlations between working memory abilities and several areas of discourse (e.g., efficiency, number of words per T-unit, cohesiveness). Hay and Moran (2005) found a strong positive relationship between working memory skills and language measures including: number of different words, T-units, number of propositions, and episodic structure. There is sufficient research suggesting that impairments of executive functioning and working memory have a negative effect on abilities to produce productive, efficient, and coherent discourse after TBI. Table 2 represents a summary of studies on discourse, executive functioning, and working memory.

Table 2—Discourse, Executive Functioning, and Working Memory Studies						
Source	***Age Range # of Subjects***	***Discourse Type***	***Task***	***Stimulus***	***Discourse Measure***	***Findings***
Smith, Heuerman, Wilson, & Proctor (2003)	-18.5-24.9 years -25 participants -Normal Adolescents	Oral, written	Picture description, 2 personal narratives	*Boston Diagnostic Aphasia Examination* "Cookie Theft Picture", participant's "most memorable summer"	Productivity, efficiency, coherence	-Subjects were more productive in personal narratives when speaking and writing rather than picture descriptions -More efficient when speaking than writing in both personal narratives and picture descriptions -No significant differences found for local or global coherence in oral and written -No significant correlation between productivity and efficiency of discourse and verbal working memory
Wilson & Proctor (2000)	-18-22 years -8 participants	Oral, written	Picture description	"Cookie Theft Picture"	Productivity, efficiency, cohesion, mazes,	-Participants with CHI had deficits in oral productivity and local coherence -CHI participants used more CUs when describing a picture and did not link concepts between sentences -Written productivity, efficiency, and lexical cohesion were related to individual executive function and working memory skills

						-Written local coherence associated with CHI performance
Davis & Coelho (2004)	-22-40 years (mean 30) -8 participants	Oral	Storytelling, story retelling	Illustrated story shown for storytelling, then taken away for retelling	Cohesion, coherence, accuracy	Deficits in referential cohesion, local coherence, and accuracy narration
Proctor, Wilson, Sanchez & Wesley (2000)	-18;9 year mean (SD 2 years) -8 with CHI -8 matched controls	Oral	Executive functioning and working memory	*Scales of Cognitive Ability for Traumatic Brain Injury*, the *Profile of Executive Functioning*, *Recognition Memory Test* of the *Goldman-Fristoe-Woodcock Auditory Skills Test Battery*	Goal selection, planning, sequencing, initiation, execution, time sense, awareness of deficits, self-monitoring	-Showed a relationship between executive functioning and working memory for both the participants with CHI and the control group -Positive correlations between goal setting, planning and sequencing, awareness of deficits, and self-monitoring ratings -Significantly lower working memory scores for CHI participants -Executive functioning skills were significantly different, especially in those classified as moderate, mild, or severe (MMS). Most of these skills were higher functioning.
Youse & Coelho (2005)	-16-69 years -55 participants	Oral	Picture generation, story retelling	19 Picture Story, Story Generation with a Normal Rockwell Painting	Within-sentence (T-unit analysis) and between sentence level	-Significant relationship between working memory scores and cohesiveness and efficiency in story retelling

					(cohesion and grammar)	and story generation narratives -Story retelling analysis indicated modest-positive correlation between working memory and number of words per T-unit, number of subordinate clauses per T-unit, number of complete ties out of total ties (cohesiveness), and number of total episodes -Modest-positive correlation between working memory and number of subordinate clauses per T-unit
Hay & Moran (2005)	-9;5-15;3 years -9 participants with TBI -9 matched controls	Oral	Story retelling	-Story retelling of an audio fable played twice -Expository discourse by retelling procedural discourse tapes played twice	T-unit analysis, episodic structure, global components, providing moral concepts, inference	-Overall deficits in discourse in children with CHI compared to control group -Both groups found expository discourse task easier than developing a moral lesson from the fable discourse test -No significant correlation between working memory and providing moral concepts -Strong positive correlation between working memory and language and information domains

Treatment of Discourse

There is little empirical evidence on the outcomes of treatment by speech-language pathologists on discourse for patients with TBI. Treatment is required when professionals decide that the communication disorder will have a significant impact on the patient's life (Coelho, 2007). Although there are no specific guidelines for treatment of discourse as a result of TBI, there are some areas for clinicians to focus on, including discourse components, higher order language functions, social skills, and various cognitive abilities (Coelho).

Therapy approaches. There are three approaches to treating discourse after TBI: the discourse abilities approach, the higher order language approach, and the social skills approach. The discourse abilities approach to therapy emphasizes the area of an individual's discourse that is most impaired and focuses on the primary components of that area of discourse (Coelho, 2007). The higher order language approach to therapy links linguistic and cognitive processes in treatment. For example, clinicians simultaneously target auditory comprehension and memory, recognition and expression of semantic attributes of words, or lexical-semantic manipulation and attention. Targeting two skills simultaneously can help improve discourse or language skills in the context of cognitive skills that may also be at a deficit (Coelho).The social skills approach to therapy focuses on the behavioral communication disorders that may occur after TBI. Discourse and behavior are targeted by creating scripts and practicing or role playing conversations that can occur in the patient's everyday life. This approach encourages the clinician to give direct instruction and specific feedback to promote self-monitoring of communication behaviors (Coelho). Several forms of cognitive therapy have been used to treat discourse impairments. Attention, executive functioning, and working memory are components of cognition that are commonly targeted within discourse intervention (Coelho).

Discourse treatment research. Recent research on discourse treatment has begun to investigate effective forms of treatment. Youse and Coelho (2009) developed a treatment for improving conversational discourse which focused on developing attention skills in two adults with CHI. The design of the study was A-B-A-C-A. Two initial baseline probes were taken by requiring participants to have 10 minute conversations with two unfamiliar partners. Each conversation probe was transcribed and analyzed for response appropriateness. Response appropriateness was divided into two categories: speaker initiations and speaker responses. Obliges (i.e., utterances that require a specific response) was one sub-category of speaker initiation. A second sub-category of speaker initiations was comments, or utterances that do not require a specific response. Speaker responses also had two sub-categories—adequate and adequate plus. Adequate was defined as a response that meets the demands of an obligation. Adequate plus is an expansion of adequate in that it exceeds the speaker's obligation by adding additional, nonessential information. Previous research showed those with CHI used fewer comments and excessive adequate plus responses in conversation (Youse & Coelho, 2009).

After documenting an initial baseline of conversational discourse (i.e., response appropriateness) and attention abilities, researchers administered the Attention Process Training II (APT) treatment protocol (Sohlberg, Johnson, Paule, Raskin, & Mateer, 1994) for six to eight weeks. The APT is a therapy program that aims to increase attention levels by using, manipulating, and repeating auditory stimuli. The APT addresses multiple elements of attention, including sustained, selective, alternating, and divided. Reassessment was administered to assess progress in attention and in discourse. A second treatment, the Interpersonal Process Recall (IPR) (Helffenstein & Wechsler, 1982), was administered for six to eight weeks after APT training. The IPR treats communication disorders that are common after CHI by using feedback

via videotapes, modeling, coaching, and rehearsal. Participants were videotaped in conversation with another communication partner (familiar or unfamiliar); the participant then watched the video and identified areas of communication that were problematic. The clinician then reviewed the video with the client, modeling any areas of communication that needed to be improved and rehearsed skills with the client. After treatment, reassessment was completed to track progress in attention and discourse. A follow-up evaluation was completed four weeks after treatment dismissal to assess carryover (Youse & Coelho, 2009).

Participant 1 did not benefit from this treatment. Results indicated that neither attention nor discourse abilities improved throughout both of the treatments. Although participant 2 made minor improvements in attention, the degree of change was not significant. No changes were noted in discourse skills, either. (Youse & Coelho, 2009).

Delano (2007) conducted a study designed to investigate the effects of treatment on written language performance in three adolescents with Asperger syndrome. Participants were given a situation and asked to write a persuasive essay, from which a baseline writing sample was taken and analyzed for number of words and number of functional elements. Participants were given a situation and writing directions about the intention of the essay (Delano, 2007).

After baselines were established, the self-regulated strategy development (SRSD) model of writing instruction was implemented. The SRSD program taught strategies for planning, writing, revising, editing, and monitoring of writing. Interactive learning was emphasized using video recordings of the student accurately accomplishing the targeted skill. This encouraged the student to gain targeted skills independently (Delano, 2007).

Researchers filmed the participants using self-monitoring skills to plan, write, edit and revise a paper. In the video, the student counted the number of words that were in a provided

essay, recording the number of words on a bar chart to determine if a length requirement was met. The student then set new goals for the next session. Participants progressed to higher level writing skills after increasing the number of words per essay by 10% for three consecutive sessions. The participants watched the same self-monitoring video before each treatment session. Participants were then required to record the skills achieved during the session by tracking progress on a blank bar chart (Delano, 2007).

After participants completed the number of words in SRSD intervention, they advanced to the functional essay elements treatment. Researchers made a video of the individual participants using self-monitoring skills to plan and write a persuasive essay. The mnemonic TREE (topic sentence, reasons, explanation, reasons, ending) was used in the videos to guide the participants in organizing an essay (Delano, 2007).

Results indicated that the SRSD intervention program significantly increased the amount of words per essay for all three participants. Baseline results showed that the average number of words written per essay was 100 for Participant 1, 52 for Participant 2, and 17 for Participant 3. After SRSD intervention, average word number per essay increased to 384 for Participant 1, 102 for Participant 2, and 46 for Participant 3 (Delano, 2007).

A follow-up reassessment after completion of the SRSD intervention program for functional essay elements showed that the participants also increased the use of functional essay elements. Initial baseline results showed that Participant 1 averaged 3 elements, Participant 2 averaged 3 elements, and Participant 3 averaged 2 functional essay elements per essay. Reassessment taken after SRSD intervention indicated that Participant 1 had increased the production of functional essay elements to 11, Participant 2 had increased to 17 per essay, and Participant 3 had increased to an average of 10 functional essay elements. The author suggested

that the increase in functional essay elements may have been due to an increase in number of words per essay (Delano, 2007).

Follow-up probes were completed three months after dismissal from treatment. It was found that all three participants used more words per essay than what was recorded in the baseline. Two of the three participants maintained gains in number of total words when reassessed three months after treatment. lmprovements in functional essay elements were not maintained by two of the three participants; the third participant's abilities declined in this targeted area (Delano, 2007).

Research suggests that treatment protocols for discourse are ineffective. Youse and Coelho (2009) developed a treatment protocol for oral discourse by targeting attention using APT and communication disorders associated with TBI using IPR. After treatment, 10 minute conversations with unfamiliar listeners were recorded and analyzed for response appropriateness. No significant gains in oral discourse secondary to treatment of attention and other communication disorders were found. Delano (2007) studied a treatment protocol in written discourse of adolescents with Asperger syndrome that produced some immediate success in number of words and number of functional essay elements. However, probing three months after treatment dismissal indicated that the participants did not maintain written discourse gains made in therapy. Table 3 represents a summary of studies on the treatment of discourse.

Table 3—Studies on the Treatment of Discourse

Source	*Age Range # of Subjects*	*Discourse Type*	*Treatment Approach*	*Discourse Stimulus*	*Discourse Measure*	*Findings*
Youse and Coelho (2009)	Two adult subjects with CHI	Oral Discourse	-Attention Process Training II (APT) for 6-8 weeks -Interpersonal Process Recall (IPR)6-8 weeks	10 minute conversations with two unfamiliar partners	-Response appropriateness: -Speaker initiations (obliges, comments) -Speaker responses (adequate and adequate plus) -Feedback via videotapes, modeling, coaching, and rehearsal from clinician and self	- Participant 1 had no benefit -Participant 2 had minor improvements in attention, but was not significant -No changes noted in discourse skills
Delano (2007)	Three adolescents with Asperger syndrome.	Written Discourse	-Self-regulated strategy development (SRSD) model of writing instruction -Filmed participants using self-monitoring skills and then watched the same video before each treatment session -Functional essay elements treatment; video of individual participants using self-monitoring skills using the TREE mnemonic (topic sentence, reasons, explanations, ending)	Given a situation and asked to write a persuasive essay	-Number of words Functional elements -Planning, writing, revising, editing, and monitoring writing -Participants recorded the skills achieved during sessions by tracking progresses on blank bar charts -Videos watched prior to each session, where the participants used the tree mnemonic	-SRSD intervention significantly increased the amount of words per essay and functional essay elements for all three participants -Three months after dismissal from treatment: -Two of the three participants maintained gains in total number of words -Functional essay elements were not maintained by two of the three participants

Summary

TBI is a common injury that drastically impacts communication skills which contributes to changes in independent, functional life skills. Oral and written discourse are modes of communication that are often affected after TBI. Although the effect TBI has on discourse has been well-researched, there is minimal insight on the impact of treatment of discourse after TBI. Research in treatment of oral discourse after TBI by Youse and Coelho (2009) was ineffective. Participants did not benefit from therapy targeting increasing attention levels or from watching videos that modeled discourse communication goals. Delano developed a course of therapy that was successful in treating written discourse in three participants with Asperger's. However, follow-up reassessments showed that the treatment did not carryover for functional aspects of written discourse. More research needs to be done in this area to help those affected by TBI regain the written discourse they had before the injury.

Three research questions were asked in this study:

1. Do participants with TBI show reduced performance in areas of executive functioning, working memory, and inhibition?
2. Do written discourse samples of participants with head injury show difficulty with productivity, efficiency, and coherence?
3. Do individual targets of productivity, efficiency, and coherence improve after treatment?

CHAPTER III

Method

The purpose of this study was to test the efficacy of a treatment protocol to improve written discourse in subjects with closed head injury (CHI). Treatment targeted individual needs for improvement in written productivity, efficiency, and global and local coherence.

Participants

Two college students with a medical history of CHI participated in this study. Subjects were between the ages of 23 and 25 (mean age 24). The age of injury was between 16 and 19 with a mean of 17.5 years. Time since injury ranged between 3 years, 7 months and 9 years, 4 months with a mean of 6 years, 5 months. College students were chosen for this study because CHI is more common in the age range of 15 to 24 years. Participants were recruited from the Eastern Illinois University campus as well as the surrounding community. The study consisted of two males, both of whom were right handed. Socioeconomic background was determined by the mother's educational background (Entwisle & Astone, 1994). Potential participants with any neurological or learning disorders other than CHI were excluded from the study.

Hearing and vision screenings were given to participants prior to treatment. Hearing screening included an audiological screening of 1000 Hz, 2000Hz, 3000 Hz and 4,000 Hz at 20dB bilaterally. Vision screening was tested by requiring participants to name elements of a picture. Motor skills were also tested by an ability to write or type legibly. Table 4 is a summary of individual participant characteristics.

Table 4
Participant Information

	Participant 1	Participant 2
Information		
Age	25	23
Gender	Male	Male
Racial/Ethnic Background	White; non-Hispanic	White; non-Hispanic
Handedness	Right	Right
Mother's Education Level	2-year college degree	Few years of college
CHI Information		
Cause of CHI	All-terrain vehicle accident	Car accident
Age of injury	16	19
Time since injury	9 years; 4 months	3 years; 7 months
Medical diagnoses prior to CHI	None	None
Length of coma	None	2 days
Length of hospitalization	None	2 months
Previous therapy	Not available	Speech & Language→ 2 months Occupational → 2 months Physical → 9 months No current therapy

Testing. Cognitive skills associated with discourse are working memory, selective attention, and executive functioning. Participants were tested to determine levels of deficits in cognitive skills. Tests included the *Stroop Test: Victoria Version* (Regard, 1981), the *Goldman-Fristoe-Woodcock Recognition Memory Subtest* (Goldman et al., 1974), *The Behavioral Rating Inventory of Executive Function—Adult Version* (Roth, Isquith, & Gioia, 2005), Test results were used to determine individual cognitive skills.

The *Stroop Test* (Regard, 1981) was administered to assess selective attention of individual participants. The three tasks given included naming colors of dots, naming colors of common words, and naming colors that conflicted with the written word (e.g., the word "red" printed in blue ink). Data collection included time to complete the task and number of errors.

Verbal working memory abilities were determined by the *Goldman-Fristoe-Woodcock Recognition Memory Subtest* (RMT) (Goldman et al., 1974). Participants judged whether a word

was used previously in an audio tape recording of a 110 words. Scores were determined by total number of correct responses.

The Behavioral Rating Inventory of Executive Function—Adult Version (BRIEF-A) (Roth et al., 2005), a questionnaire, was given to each participant and a significant other of each participant to assess executive functioning skills. The BRIEF-A measures behavioral regulation and meta-cognition. Areas of behavioral regulation are emotional control, abilities to shift from one situation to another, and controlling impulses. Meta-cognition includes abilities to initiate behavior, generate ideas, remember information to complete a task, plan future events, set goals, organize ideas, and self-assess performance. Raw scores from the BRIEF-A were converted to T-scores with a mean of 50 and a standard deviation (SD) of 10. T-scores above 65, 1.5 SD above the mean, were considered clinically impaired by the authors of the test. For the purposes of this study, T-scores above 60, 1 SD above the mean, were considered as a cognitive deficit.

Experimental Stimuli and Procedures

Two written narratives were collected from each participant. Each narrative was written on white ruled paper in ink pen. Discourse tasks were elicited using a picture description and a personal narrative. Order of tasks was counter balanced. There was not a time limit on the written discourse tasks. Verbal cues were given to participants encouraging expansion of discourse if it was less than one page.

Elicitation tasks.

1. The "Cookie Theft" picture of the *Boston Diagnostic Aphasia Examination* (Goodglass, Kaplan, & Barresi, 2001) was used to elicit the picture description narrative. The "Cookie Theft Picture is displayed in Appendix B.

2. Participants were asked to describe their best summer for the elicitation of the personal narrative.

Transcription. Each narrative was transcribed by the examiner and divided into communication units (CUs). A communication unit is an independent clause and all of its modifiers. When compound sentences were used in a narrative, the CU was divided at the coordinating conjunction. Transcription procedures were based on those suggested by Hughes, McGillivray, and Schmidek (1997).

Discourse measures. Each narrative was analyzed by the examiner for productivity, efficiency, and global and local coherence. Productivity was measured and reported as the total amount of CUs in a narrative sample. Previous research found that control participants wrote a mean of 10 CUs about the Cookie Theft picture (range=5.00-21.00, *SD*=6.26) (Wilson & Proctor, 2000). For personal narratives, controls wrote a mean of 8.25 CUs (range=5.00-11.00, *SD*=2.75) (Wheat & Wilson, 2006). Efficiency was measured by dividing the number of total words per sample by the number of CUs in the same sample; this calculated the mean length of communication unit (MLCU). Efficiency for controls when writing about the Cookie Theft picture averaged 11.70 MLCU (range=9.14-14.00, *SD*=1.55) (Wilson & Proctor). Personal narrative efficiency for controls averaged 12.32 MLCU (range=11.70-13.00, *SD*=0.55) (Wheat & Wilson). Global coherence was rated on a 5-point scale (Wilson & Proctor) and compared the relationship of each CU to the topic of the narrative. Mean global coherences rating for controls on the Cookie Theft picture were 4.38 on a scale of 5 (range=2.00-5.00, *SD*=1.06) (Wilson & Proctor). Mean global coherence rating for controls on personal narratives was 4.50 (range=4.00-5.00, *SD*=0.58) (Wheat & Wilson). Local coherence was rated on a 5-point scale and compared the relationships of consecutive CUs (Wilson & Proctor). Mean local coherence rating for

controls on picture narratives was 4.25 (range=2.00-5.00, *SD*=1.17) (Wilson & Proctor). Mean local coherence rating for controls on personal mean 3.75 (range=2.00-5.00, *SD*=1.50) (Wheat & Wilson). Coherence measures were based on a 5-point scale developed by Wilson and Proctor (2000) (Appendix C). Individual therapy targets were established based on each participant's writing performance as well as client identified needs. The means for discourse measures from previous research studies were used in establishing expectations for performance on discourse measures.

Treatment

Treatment protocols were developed according to each participant's expressed concerns and initial discourse analysis. Areas that were treated included productivity, efficiency, global coherence, and local coherence. Treatment focused on reducing cognitive demands during writing tasks. Participant 1 was treated for four weeks and Participant 2 was treated for six weeks.

Productivity. Productivity, the number of CUs necessary to communicate an idea, was treated by providing participants with an outline to organize thoughts and ideas that were essential to the written samples. An outline was used to reduce cognitive demands. Outlining allowed participants to plan and organize additional topics for each writing sample. Specific feedback (e.g., "Let's write more") was given to participants to encourage expansion of CUs for each topic.

Efficiency. Efficiency was treated with a two-step technique. The first stage was to prompt the participant to read each written sentence aloud and self-judge conciseness (average number of words per CU). In the second step, participants counted the number of words in each

sentence. Participants were told to write sentences up to 10 words in length. If sentences were trite or verbose, specific feedback was given to adjust sentences into concise statements.

Coherence. Global coherence is the connectedness between an individual CU and the topic of the written narrative. Participants self-assessed global coherence by reading each CU verbally and deciding if that CU was related to the topic of the narrative. Specific feedback was given when CUs were determined to be unrelated to the topic. Local coherence, the logical progression of ideas, was treated by a self-regulation task similar to the global coherence treatment. Participants compared individual CUs with preceding and subsequent CUs. The clinician provided specific feedback to guide the participant to write a connected sample.

Reliability

Inter-rater, point to point reliability on each discourse measure was completed on all samples. Prior to completing reliability, the examiner and faculty mentor reviewed transcripts and reached agreement on the identification of CUs and on word counts for CUs. When errors were identified, corrections were made. After completing initial reliability comparisons, numerical tallies were discussed until agreement was reached for productivity and efficiency measures. Reliability for global coherence and local coherence was 100% and 90% respectively.

Experimental Questions

This study investigated the following questions:

1. Do participants with TBI show reduced performance in areas of executive functioning, working memory, and selective attention?
2. Do written discourse samples of participants with head injury show difficulty with productivity, efficiency, and coherence?
3. Do individual targets of productivity, efficiency, and coherence improve after treatment?

CHAPTER IV

Results

The purpose of this study was to test the efficacy of a treatment protocol for written discourse improvement in participants with closed head injury (CHI).

Question 1

The first research question asked, "Do participants with TBI show reduced performance in areas of executive functioning, working memory, and inhibition?"

Results on the *Stroop*, *RMT*, and *BRIEF-A*, suggested that the two participants with TBI showed deficits in areas of cognitive functioning. Participant 2 showed more cognitive deficits than Participant 1. Table 5, listed under Question 2, represents the participants' scores on the *Stroop*, *RMT*, and *BRIEF-A*.

Participant 1 showed a *BRIEF-A* score for inhibition 1 SD above the mean and a *Stroop* score 1 SD below the mean. Participant 2 showed deficits on the *Stroop* (selective attention), and task monitoring (*BRIEF-A*). He also scored 1 SD below the mean on working memory (*RMT*). Additional areas on the *BRIEF-A* (initiate, plan/organize, organization of materials, and inhibit) were at or above 1 SD from the mean. Table 5 represents executive functioning, working memory, and inhibition scores.

Table 5
Participant Executive Functioning, Working Memory, and Inhibition

	Participant 1	Participant 2
Stroop		
Dots	50th percentile	2nd percentile*
Words	50th percentile	2nd percentile*
Colors	16th percentile*	1st percentile*
RMT	31st percentile	15th percentile*
BRIEF-A Self-Report		
Global Executive Composite (GEC)	46	55
Behavioral Regulation Index (BRI)	49 (Inhibit: 60*)	48
Metacognition Index (MI)	44	60* (Initiate: 60*) (Plan/Organize: 60*) (Organization of Materials: 61*)
BRIEF-A Informant Report		
Global Executive Composite (GEC)	36	54
BRI	37	51 (Inhibit: 63*)
MI	37	56 (Task monitor: 69*) (Organization of Materials: 61*)

* Results at least 1 standard deviation (SD) from the mean.
BRIEF-A results are reported in T-scores.

Question 2

The second research question was, "Do written discourse samples of participants with head injury show difficulty with productivity, efficiency, and coherence?"

Assessment of baseline written narrative samples showed that both participants with CHI showed reduced performance on productivity, efficiency, and coherence when compared to previous research controls. Baseline samples of picture-elicited and personally-generated narratives for both participants are represented in Appendix D.

Participant 1 showed performance below the mean rating for controls on efficiency and global coherence on the picture elicitation and on the personal narrative. Local coherence rating was below mean control performance for the picture description (Wheat & Wilson, 2006; Wilson & Proctor, 2000). Participant 2 wrote fewer CUs than the mean of controls for the picture description task. For efficiency, Participant 2's MLCU was greater than that of control for both discourse tasks. Global and local coherence for picture and personal narratives were lower than the mean for controls.

Therapy targets for Participant 1 included efficiency and coherence. Participant 2's therapy targets were productivity, efficiency, and coherence. Table 6 represents participant baseline results and areas targeted in therapy.

Table 6
Participant Discourse Baseline Results

	Participant 1	Participant 2
Cookie Theft		
Productivity	19 CUs	6 CUs*
Efficiency	13 Words/CU*	14.1 Words/CU*
Global Coherence	4*	4*
Local Coherence	4*	3*
Best Summer		
Productivity	13	16 CUs
Efficiency	16.2 Words *	13.6 Words/CU*
Global Coherence	4*	3*
Local Coherence	4*	1*

* Identifies therapy targets

Question 3

The third research question asked, "Do individual targets of productivity, efficiency, and coherence improve after treatment?"

After four weeks of treatment, Participant 1 had improved efficiency in both picture and personal narratives. Global and local coherence improved in both picture and personal narratives. Productivity was not targeted in Participant 1. Productivity in picture description was targeted in treatment for Participant 2. After six weeks of treatment, Participant 2 had increased productivity for picture narratives. Efficiency of picture narratives improved for Participant 2, but personal narrative efficiency improvement was not substantial. Participant 2's global coherence improved one rating level for personal narratives, but stayed consistent from baseline measures for picture narratives. Local coherence improved in both picture and personal narratives for Participant 2.

Figures 1-7 and Tables 7-13 show weekly progress in targeted areas for each participant.

Productivity

Picture narrative productivity results for Participant 2 are illustrated in Figure 1 and Table 7.

Figure 1

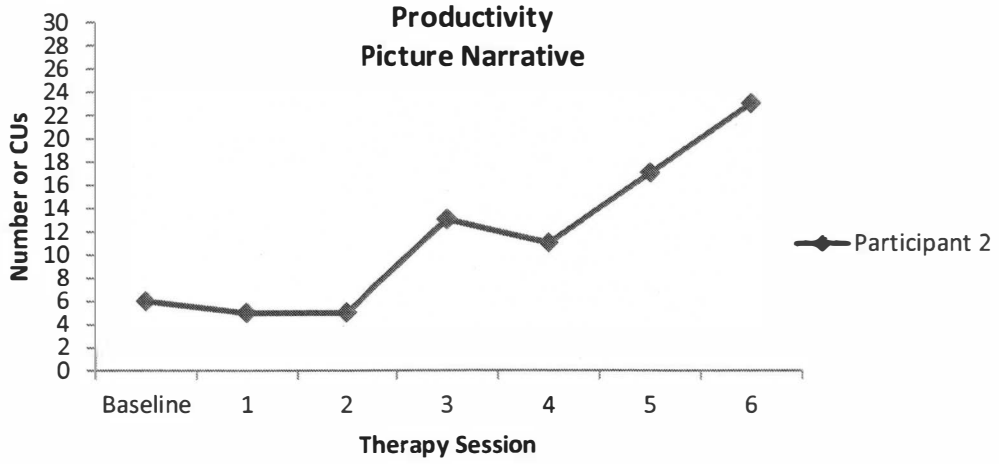

Table 7
Productivity—Picture Narrative

	Participant 2
Baseline	6
Week 1	5
Week 2	5
Week 3	13
Week 4	11
Week 5	17
Week 6	23

Participant 2 had 6 CUs in his baseline picture narrative sample. The mean number of CUs for Participant 2's productivity was 11.43 (range=5.00-23.00, *SD* = 6.83). Participant 2 had a productivity goal of 10 CUs per picture narrative. The productivity goal was achieved with treatment, as productivity increased from 6 CUs to 23 CUs.

Efficiency

Figure 2 and Table 8 represent efficiency progress for picture narratives in Participant 1 and Participant 2.

Figure 2

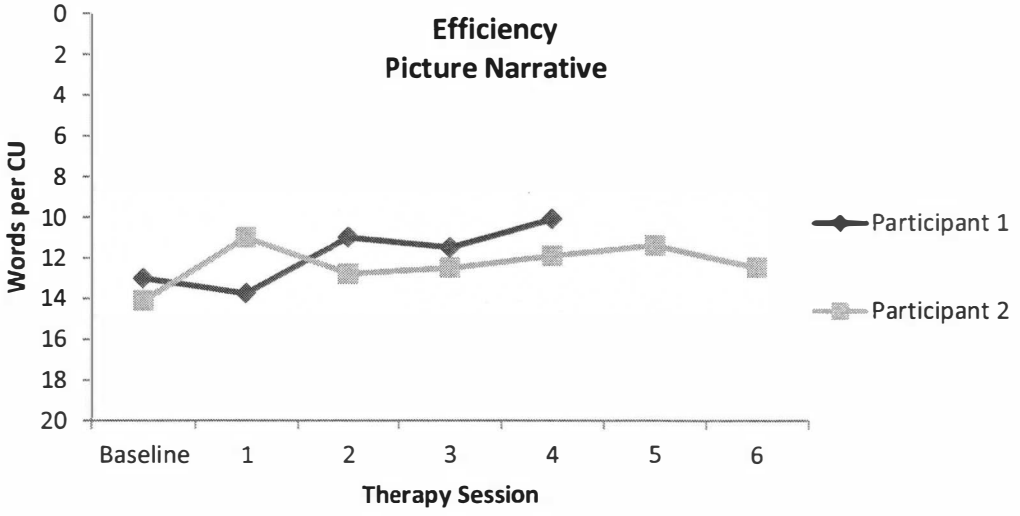

Table 8
Efficiency—Picture Narrative

	Participant 1	Participant 2
Baseline	13	14.1
Week 1	13.75	11
Week 2	11	12.8
Week 3	11.5	12.5
Week 4	10.1	11.9
Week 5	—	11.4
Week 6	—	12.5

Participant 1 had an average of 13 words per CU in his baseline picture narrative sample. narrative efficiency results for Participant 1 are illustrated in Figure 2 and Table 7. The mean number of words per CU was 11.87 (range=10.10-13.75, *SD* =1.49). Participant 1 had an efficiency goal of 10 words per CU for picture narratives. He was able to achieve this goal by the last treatment session.

Participant 2 had an average of 14.1 words per CU in his baseline picture narrative sample. Picture narrative efficiency results for Participant 2 are also illustrated in Figure 3 and Table 8. The mean number of words per CU was 12.31 (range=11.00-14.10, *SD* =1.02). Participant 2 had an efficiency goal of 10 words per CU for picture narratives. Although Participant 2 did not achieve 10 words per CU throughout 6 weeks of therapy, he did improve his efficiency by reducing as many as 4 words per CU.

Personal narrative efficiency results for Participant 1 and Participant 2 are illustrated in Figure 3 and Table 9.

Figure 3

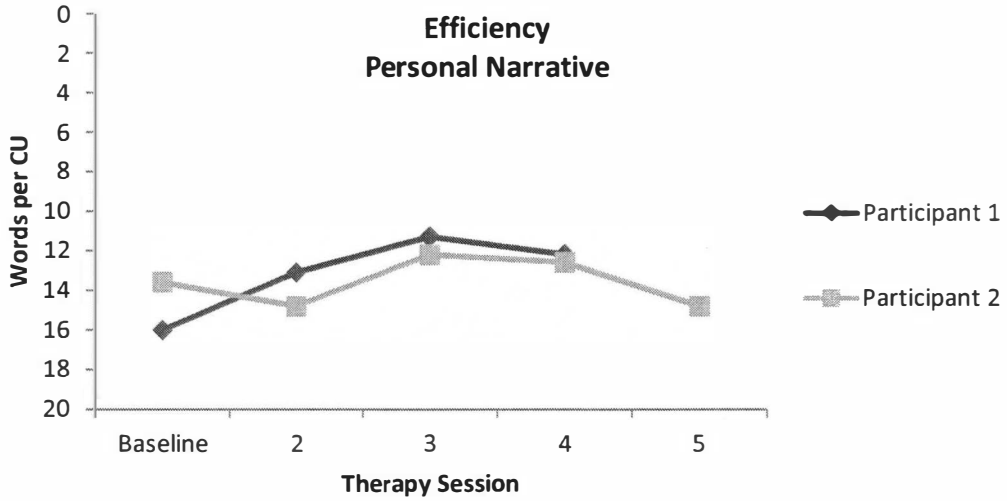

Table 9
Efficiency—Personal Narrative

	Participant 1	Participant 2
Baseline	16	13.6
Week 2	13.1	14.8
Week 3	11.3	12.2
Week 4	12.2	12.6
Week 5	—	14.8

Participant 1 had an average of 16 words per CU in his baseline personal narrative sample. Personal narrative efficiency results for Participant 1 are illustrated in Figure 3 and Table 8. The mean number of words per CU was 13.15 (*SD* =2.04, range=11.30-16.00). Participant 1 had an efficiency goal of 10 words per CU for personal narratives. Although Participant 1 did not achieve 10 words per CU throughout 4 weeks of therapy, he did improve efficiency by reducing as many as 5 words per CU.

Participant 2 had an average of 13.60 words per CU in his baseline personal narrative sample. Personal narrative efficiency results for Participant 2 are illustrated in Figure 4 and Table 9. The mean number of words per CU was 13 (range=12.20-14.80, *SD* =1.21). Participant 2 had an efficiency goal of 10 words per CU for personal narratives. Participant 2 did not achieve

10 words per CU throughout 6 weeks of treatment. He was inconsistent in personal narrative efficiency, as scores fluctuated between 12.2 and 14.8 words per CU during treatment.

Global Coherence

Figure 4 and Table 10 show global coherence picture narrative results for both participants.

Figure 4

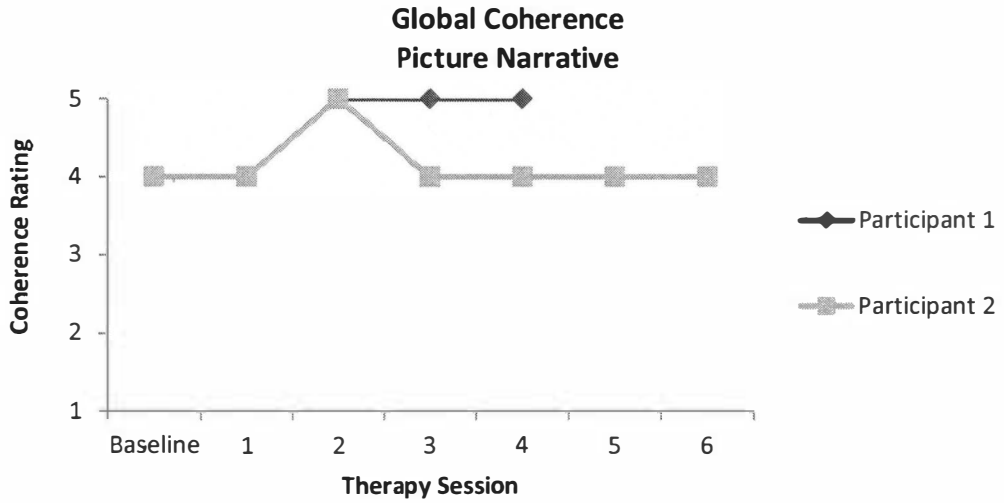

Table 10
Global Coherence—Picture Narrative

	Participant 1	Participant 2
Baseline	4	4
Week 1	4	4
Week 2	5	5
Week 3	5	4
Week 4	5	4
Week 5	—	4
Week 6	—	4

Participant 1 scored a global coherence rating of 4 on the baseline picture narrative. The mean global coherence rating for Participant 1's picture narratives was 4.6 (range=4.00-5.00, *SD* =0.55). Participant 1 had a global coherence rating goal of 5 for picture narratives. Participant 1 was able to achieve this goal and maintain a global coherence rating of 5 for 3 weeks.

Participant 2 also scored a global coherence rating of 4 on the baseline picture narrative. The mean global coherence rating for Participant 2's picture narratives was 4.14 (range=4.00-5.00, SD=0.38). Participant 2 had one global coherence rating goal of 5 for picture narratives. Participant 2's global coherence ratings stayed stable at 4 throughout treatment with the exception of a rating of 5 in the second week of treatment.

Figure 5 and Table 11 illustrate global coherence ratings throughout treatment for both participants.

Figure 5

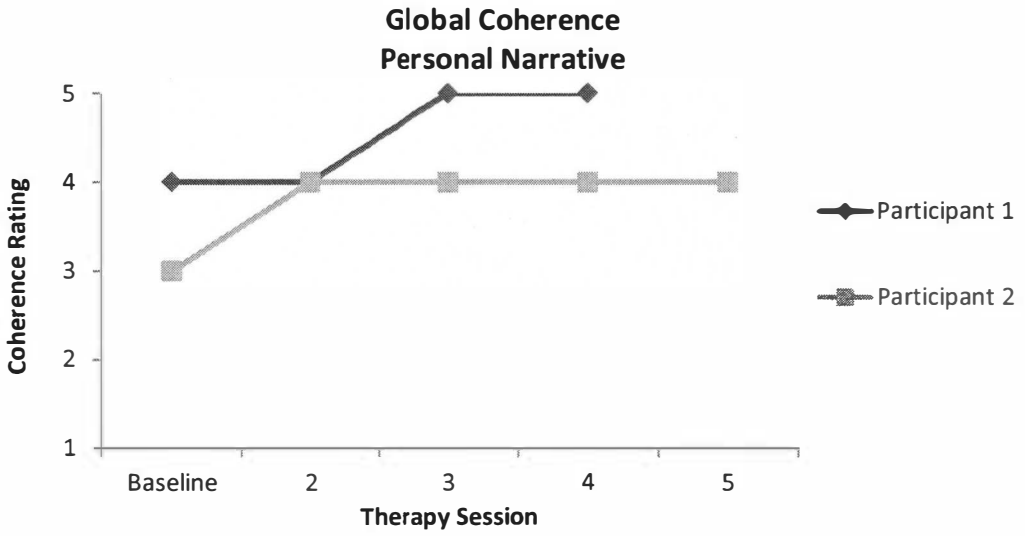

Table 11
Global Coherence—Personal Narrative

	Participant 1	Participant 2
Baseline	4	3
Week 2	4	4
Week 3	5	4
Week 4	5	4
Week 5	—	4

Participant 1 scored a global coherence rating of 4 on the baseline personal narrative. The mean global coherence rating for Participant 1'a personal narratives was 4.5 (range=4.00-5.00

SD = 0.58). Participant 1 had a goal of a global coherence rating of 5 for personal narratives. Participant 1 met this goal in the final two treatment sessions.

Participant 2 scored a global coherence rating of 3 on the baseline personal narrative. The mean global coherence rating for Participant 2's personal narratives was 3.8 (range=3.00-4.00, *SD* = 0.45). Participant 2 had a goal of a global coherence rating of 5 for personal narratives. Participant 2 did not meet his goal for personal narrative global coherence, but he did increase his coherence by one rating level.

Local Coherence

Figure 6 and Table 12 illustrate local coherence ratings for both participants' picture narratives.

Figure 6

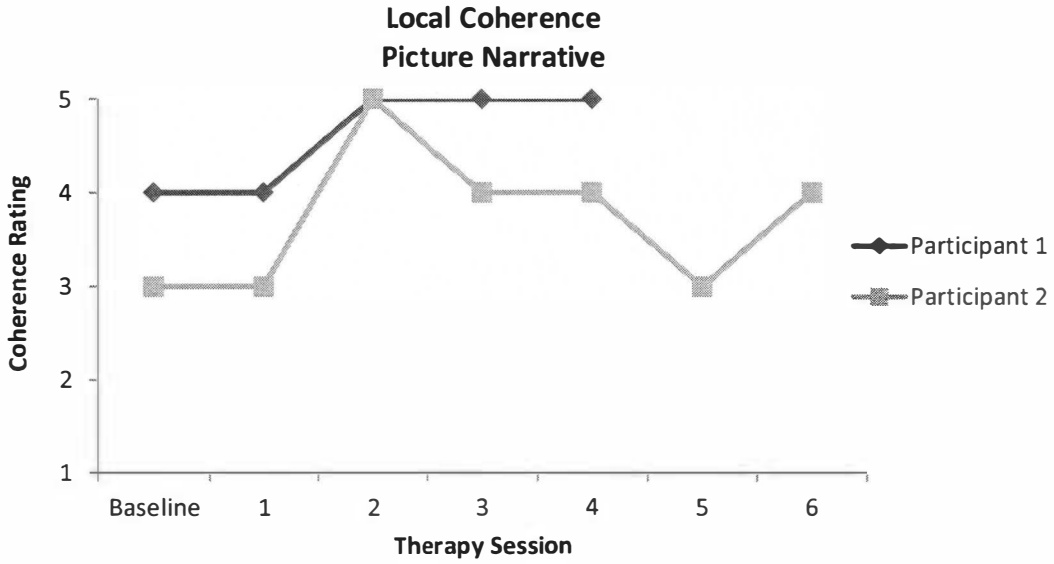

Table 12
Local Coherence—Picture Narrative

	Participant 1	Participant 2
Baseline	4	3
Week 1	4	3
Week 2	5	5
Week 3	5	4
Week 4	5	4
Week 5	—	3
Week 6	—	4

Participant 1 scored a local coherence rating of 4 on his baseline picture narrative. The mean local coherence rating for Participant 1's picture narratives was 4.6 (range=4.00-5.00, *SD* = 0.55). Participant 1 had a local coherence rating goal of 5 for picture narratives. Local coherence improved to targeted rating in the second week of treatment and continued until the Participant 1 was dismissed.

Participant 2 scored a local coherence rating of 3 on his baseline picture narrative. The mean local coherence rating for Participant 2's picture narratives was 3.71 (range=3.00-5.00, *SD* =0.76,). Participant 2 had one local coherence rating goal of 5 for picture narratives. Local coherence improved, but not consistently, throughout the six weeks of treatment. Participant 2 did reach a local coherence rating of 5 once during treatment, but was unable to maintain desired local coherence scores.

Figure 7 and Table 13 illustrate personal narrative local coherence ratings for both participants.

Figure 7

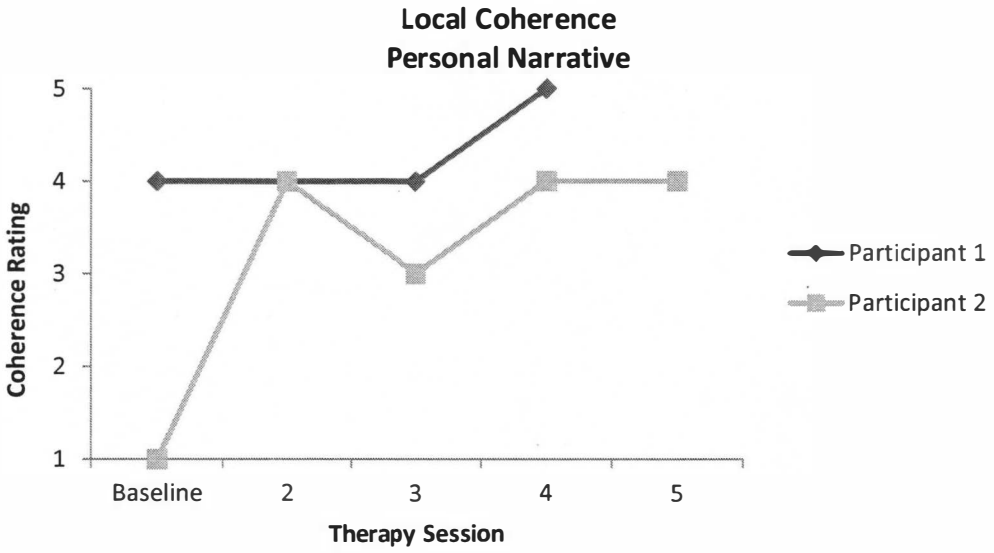

Table 13
Local Coherence—Personal Narrative

	Participant 1	Participant 2
Baseline	4	1
Week 2	4	4
Week 3	4	3
Week 4	5	4
Week 5	—	4

Participant 1 received a local coherence rating of 4 on his baseline personal narrative. The mean local coherence rating for Participant 1's personal narratives was 4.25 (range=4.00-5.00, *SD* = 0.50). Participant 1 had one local coherence rating goal of 5 for personal narratives. Participant 1 achieved his local coherence goal for personal narratives in the final week of treatment.

Participant 2 received a local coherence rating of 1 on his baseline personal narrative. The mean local coherence rating for Participant 2's personal narratives was 3.20 (range=1.00-4.00, *SD* = 1.30). Although Participant 2 did not receive a local coherence rating of 5 for

personal narratives, his local coherence did improve with treatment. Participant 2 increased his local coherence score in personal narratives by 3 rating levels.

CHAPTER IV

Discussion

The current study was conducted to evaluate the effectiveness of a treatment protocol for written discourse improvement in adolescent participants with CHI. The following questions were asked: 1) Do participants with TBI show deficits in areas of executive functioning, working memory, and inhibition; 2) Do written discourse samples of participants with head injury show difficulty with productivity, efficiency, and coherence; 3) Do individual targets of productivity, efficiency, and coherence improve after treatment? Results from this study showed participants with TBI demonstrated deficits in cognitive processes, such as executive functioning, working memory, and inhibition. Participants with CHI had difficulty with productivity, efficiency, and coherence in picture and personal narrative writing samples. Treatments focused on reducing cognitive demands can benefit college students with TBI in narrative discourse by improving productivity, efficiency, and coherence.

Summary of Results

The findings of this study suggested that participants with CHI showed reduced cognitive skills. Narrative discourse samples taken from Participant 1 revealed reduced efficiency, global coherence, and local coherence. Participant 2's initial written narrative samples showed deficits in productivity, efficiency, global coherence, and local coherence. Through written discourse therapy, productivity, efficiency, global coherence, and local coherence improved.

Productivity was improved by cueing the participant with an outline to plan and organize thoughts and ideas that were essential to the written narratives. Participant 2 had difficulty with productivity, particularly in picture elicited narratives. Participant 2 did not use enough information to support each of his main ideas in his narratives prior to treatment. Once

Participant 2 was provided with an outline and was encouraged to write more, his productivity increased, by adding support to each main idea.

Reading sentences aloud to self-judge conciseness and counting words in each sentence was an effective treatment for efficiency. Prior to treatment, Participant 1 used primarily wordy sentences in written narratives, which negatively affected efficiency. Through treatment, Participant 1 was able to identify when CUs were too long. After self-judging individual CUs, Participant 1 was able to make necessary corrections so that ideas in his narrative was concise. Participant 2's reduced efficiency was attributed to the use of unnecessary descriptive words and wordy CUs. Although Participant 2 did not meet his goal of 10 words per CU, he did make gains in the succinctness of his written narratives. Eliminating unnecessary words and separating ideas into separate sentences improved Participant 2's efficiency.

Global coherence was improved by reading each sentence verbally and self-judging whether the sentence was related to the topic. Participant 1's CUs in his narratives were on topic, but he did not integrate all of his ideas to create a coherent story. This was due to reduced local coherence, as many of Participant 1's narratives lacked transition between topics. Through four weeks of treatment, Participant 1 was able to improve his global coherence and write narratives with relevant information. Participant 2's global coherence increased over the 6 weeks of treatment, but he did not meet level 5. Before treatment, Participant 2's narratives included pieces of information that were unrelated to the topic and did not add pertinent information. By targeting global coherence in treatment, Participant 2 eliminated irrelevant information from his narratives and created a coherent narrative.

Similar to global coherence, local coherence was improved by comparing individual sentences with preceding and subsequent sentences. Before treatment, Participant 1's CUs were

on topic and related to each other, but his ideas did not follow a logical progression. By learning self-judging skills to improve coherence, Participant 1 was able to write narratives with appropriate transitions between ideas. Participant 2's local coherence was reduced in his narratives; the narratives were unorganized and were not in a logical progression. After learning strategies to improve local coherence, Participant 2 was able to organize his narratives effectively and recognize when sentences were unrelated to surrounding sentences.

Results showed a difference between elicitation tasks, as participants had more difficulty on the picture elicitation than personal story elicitation. That is, with productivity, fewer CUs were written about the picture. This was especially true for Participant 2's productivity, as Participant 2 was able to write more for personal narratives than picture narratives. However, being efficient in expressing ideas was equally difficult across elicitations for both participants. Both participants had more difficulty with local coherence in the personal narrative. Wilson and Proctor (2002) suggested that a picture elicitation placed greater demands on organization since the writer had to develop an organizational structure for ideas. For personal narratives, chronology provides structure (Wilson & Proctor, 2002).

Relation to Past Research

Results from this study supported the conclusions from other studies regarding the cognitive deficits after TBI. Channon and Watts (2003) found deficits in executive functioning and inhibition in adolescents and adults with TBI. Adolescents with TBI were found to have deficits in executive functioning and working memory when compared to age and gender matched controls without TBI (Proctor et al., 2000). In the current study, Participant 1 had deficits in inhibition and executive functioning, and Participant 2 had impairments in inhibition, executive functioning, and working memory.

Findings in this study also supported previous research on the discourse impairments associated with TBI, specifically productivity, efficiency, and coherence. Wilson and Proctor (2000) found that participants with CHI had deficits in written discourse, specifically productivity, efficiency, and cohesion. These deficits were related to executive function and working memory skills (Wilson & Proctor, 2000). Youse and Coelho (2005) found that there was a relationship between working memory and executive functioning and written efficiency and productivity. In this study, selective attention (inhibition) was also found to be reduced in participants with written discourse problems. Participant 1 had difficulty with efficiency and coherence in written narratives. Participant 2 had deficits in written productivity, efficiency, and coherence.

Clinical Implications

Although the effect TBI has on discourse has been well-researched, there is minimal insight on the impact of treatment on written discourse after TBI. Research for oral discourse after TBI, by Youse and Coelho (2009), failed to show effective treatment results. Participants did not benefit from therapy targeting increasing attention levels or from watching videos that modeled discourse communication goals. Delano (2007) developed a course of therapy that was successful in treating written discourse in three participants with Asperger syndrome.. However, follow-up reassessments showed that the treatment did not carryover for functional aspects of written discourse.

The present study further explored possible direction for clinical treatment of written discourse impairments associated with TBI. Implementing the strategies used in this study (e.g., reading each sentence out loud, counting the number of words, creating an outline to organize ideas) during written discourse treatment could benefit clients with TBI. The outline strategy

facilitated planning and organization as well as self-monitoring for the progression of ideas. Use of written strategies also reduced the demands on working memory. The participants in this study benefited in all areas targeted, although some benefit was minimal, in a short period of time.

Strengths and Limitations

The strengths of this study included a strong background of research suggesting a relationship between cognitive skills and written discourse performance. A strategy-based approach, designed with the intent to reduce cognitive demands during the development of ideas, was a logical treatment approach. Single subject research design allowed each participant's writing performance to serve as his own baseline and to have individualized goals based on initial measures. The design also allowed visualization of weekly performance compared to baseline. Since each person with TBI is different, single subject research is an excellent design for use in preliminary treatment studies.

A weakness of this study was the number of weeks of treatment. While improvements were seen, especially for Participant 1, additional therapy time would have benefited Participant 2. Also, follow-up writing samples would have provided insight into the maintenance of improvements seen during the treatment phase of the study. An additional weakness of any treatment research conducted after TBI is the lack of samples reflecting the skills of the participants prior to their TBI. It cannot be assumed that performance was within normal limits prior to injury.

Future Directions

Cognitive processes, such as executive functioning, working memory, and inhibition, are common deficits after TBI. These cognitive deficits are often related to difficulty in written

discourse, especially productivity, efficiency, and coherence. There are few treatment protocols for improving written discourse after TBI. Provision of therapy over a longer period of time should be considered in future research. Future studies should include continued use of single-subject research design to investigate treatment strategies for improvement and maintenance of written discourse. Further investigation of direct therapy to improve the cognitive skills necessary for written discourse is warranted to further develop and refine successful therapy protocols.

Conclusions

The current study addressed reducing cognitive demands by using strategies for written discourse impairments associated with TBI. The findings of cognitive impairments and written discourse deficits were consistent with previous findings. Although these impairments are common after TBI, there is little research to support treatment protocols. Given the lack of evidence in the effectiveness of written discourse protocols, the present study provided a foundation to continue clinical research.

Because written discourse is a key component to academia, adequate writing skills need to be rehabilitated after TBI to increase the chance for success in the classroom. Using strategies to reduce the cognitive demands of written discourse and target productivity, efficiency, and coherence can be an effective protocol for treatment.

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Appendix A

CONSENT TO PARTICIPATE IN RESEARCH

Treatment of Written Discourse after Traumatic Brain Injury

You are invited to participate in a research study conducted by Cassie Fuller and Dr. Brenda Wilson, from the Communication Disorders and Sciences Department at Eastern Illinois University.
Your participation in this study is entirely voluntary. Please ask questions about anything you do not understand, before deciding whether or not to participate.

- **PURPOSE OF THE STUDY**

This study will investigate an individualized therapy approach to improve writing skills after traumatic brain injury.

- **PROCEDURES**

If you volunteer to participate in this study, you will be asked to:

Complete the Stroop Test: Victoria Version, the Goldman-Fristoe-Woodcock Recogniton Memory Subtest, and the Behavioral Rating Inventory of Executive Function—Adult Version to measure initial cognitive abilities. Testing will take approximately 30 minutes.

Participants will be required to write two narratives: a descriptive narrative based on a given picture and a personal narrative based on a question. Approximate time of writing will be 60 minutes.

Based on analysis of the narratives, individualized treatment programs will be constructed. Areas of the narrative that will be analyzed are productivity, efficiency, and global and local coherence.

Productivity will be treated by creating outlines to reduce cognitive demands and organize topics for each writing sample. Efficiency improvements will be targeted by prompting the participants to self-judge the conciseness of each sentence. Coherence will be treated by requiring participants to self-assess the connectedness of the sentences to the topic and to each other. Treatment will last for approximately six weeks.

- **POTENTIAL RISKS AND DISCOMFORTS**

There are no anticipated risks associated with this study.

- **POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

Academic gains can be made by participants in this study. Because written discourse is a key component to academia, adequate writing skills need to be rehabilitated after TBI so that

participants can be successful in the classroom. Research in the field of written discourse after TBI does not provide a strong protocol for improvement of functional written skills. Findings show that written discourse (specifically productivity, efficiency, and coherence) are compromised after traumatic brain injury, but no significant findings for effective treatment outcomes have been published. Findings from this study will benefit the development of therapy plans for speech-language pathologists to increase written discourse of clients with TBI.

- **CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of identifying participants by number and keeping participant information and data in a locked drawer that is only accessible by the principal investigator and the supervisor.

- **PARTICIPATION AND WITHDRAWAL**

Participation in this research study is voluntary and not a requirement or a condition for being the recipient of benefits or services from Eastern Illinois University or any other organization sponsoring the research project. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits or services to which you are otherwise entitled.
There is no penalty if you withdraw from the study and you will not lose any benefits to which you are otherwise entitled.

You may also refuse to answer any questions you do not want to answer.

- **IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about this research, please contact:

Brenda Wilson, PhD.
Faculty Sponsor
(217)581-2712
bmwilson@eiu.edu

Cassie Fuller
Principal Investigator
(815)228-6674
clfuller@eiu.edu

- **RIGHTS OF RESEARCH SUBJECTS**

If you have any questions or concerns about the treatment of human participants in this study, you may call or write:

Institutional Review Board
Eastern Illinois University
600 Lincoln Ave.
Charleston, IL 61920
Telephone: (217) 581-8576
E-mail: eiuirb@www.eiu.edu

You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with EIU. The IRB has reviewed and approved this study.

I voluntarily agree to participate in this study. I understand that I am free to withdraw my consent and discontinue my participation at any time. I have been given a copy of this form.

_____
Printed Name of Participant

_____ _____
Signature of Participant Date

Use the following signature line for minor/handicapped subjects only if applicable.

I hereby consent to the participation of _____, a minor/subject in the investigation herein described. I understand that I am free to withdraw my consent and discontinue my child's participation at any time.

_____ _____
Signature of Minor/Handicapped Subject's Parent or Guardian Date

I, the undersigned, have defined and fully explained the investigation to the above subject.

_____ _____
Signature of Investigator Date

Appendix B

Cookie Theft Picture Stimuli

Appendix C

Coherence Assessment Scale

Global Coherence

5 Ideas form integrated story about topic

4 All CUs are on topic

3 One CU strays from topic

2 Two CUs stray from topic

1 Generally off-topic

Local Coherence

5 Ideas follow logical progression

4 Each CU is related to the preceding or following CU

3 One Cu is not related to the preceding or following CU

2 Two CUs are not related to the preceding or following CU

1 More than two CUs are not related to the preceding or following CUs

Appendix D

Participant Written Discourse Baselines and Analyses

Participant 1, Cookie Theft Baseline

1. Today in the standard family home on Main Street you have many wonderful memories being made.
2. These memories will leave long in their mind as the day the boy cracked open his head and the house flooded.
3. The memory begans with the first day of summer which the mother had been looking forward to.
4. By the end of the day she would be wishing school never ended.
5. It all started with a slow morning
6. and quickly became a loud, crazy, and out of control afternoon.
7. All the fun and games ended when the boy was, from advice from his sister, dared him to get into the cookies.
8. The mother had told them they could not have any cookies until after dinner.
9. The mother`s nerves were pushed to their limits
10. so much that she forgot to turn off the sink has she was washing dishes.
11. When the water was pouring out of the sink onto the floor the boy climbed the stool to obtain forbidden cookies.
12. Then it all happened,
13. the boy fell off the stool and hit his head on the counter.
14. This was not only a loud crash,
15. it brought the mother back to reality.
16. The mother picked the boy up and rushed him to the hospital.
17. While they were gone the house continued to fill up with water.
18. When the family return, their home was water logged to the core.
19. This day lives on in their memories has the day the boy hit his head and the house flooded.

Cookie Theft Analysis	
Number of CUs (Productivity)	19 CUs
Number of Words	251 Words
Efficiency	13 Words/CU
Global Coherence	4
Local Coherence	4

TBI WRITTEN DISCOURSE TREATMENT

Participant 1, Best Summer Baseline:

1. My best summer was in 2007.
2. It has been the only summer that started in January and lasted through August.
3. This summer was spent with all of my true best friend and favorite collegues.
4. We all work together sometimes putting in 20 hour of work a day
5. and other times we just worked all through the night.
6. Summer was filled with ships, guns, and aircrafts.
7. There has never been another summer where I saw million dollar piece of machines be through off a 90 feet run way at 140 m/h fully loaded with weapons.
8. There were night we would sit 100 feet above the ocean, looking at the stars, watching F-18 hornets land and take off a ship only 1000 feet long.
9. This summer was filled with emotions of joy, pride, anger, and relief when we were deployed in Jan 2007 to the Middle East which was 100 plus degrees all summer started.
10. All these emotions would come at all hours of the day,
11. all one could do is not let the emotions over whealm them.
12. My best summer was my 2007 deployment to the Middle East on aboard the aircraft carrier U.S.S. John C. Stennis (CVN-74).
13. This is where I saw true humans working together for a common cause.

Best Summer Analysis	
Number of CUs (Productivity)	13 CUs
Number of Words	210 Words
Efficiency	16.2 Words/CU
Global Coherence	4
Local Coherence	4

TBI WRITTEN DISCOURSE TREATMENT

Participant 2, Cookie Theft Baseline:

1. In this picture Alice is not paying attention because she is day dreaming about having the extravagant life of Samantha who is sun bathing.
2. Mean while Jerry and Eileen devised a plan on Jerry to successfully attain cookies.*
3. Eileen was a lousey chair holder
4. and in exchange Jerry will end Alices daydream about Samantha.
5. However in the fall Jerry will split his head open, causing Eileen to cry and Alice to faint because she hates blood.
6. Eileen calls the ambulance, who become distracted by Samantha.

Cookie Theft Analysis	
Number of CUs (Productivity)	6 CUs
Number of Words	85 Words
Efficiency	14.1 Words/CU
Global Coherence	4
Local Coherence	3
	Indicated by an asterisk (*)

TBI WRITTEN DISCOURSE TREATMENT

Participant 2, Best Summer Baseline:

1. The greatest summer of my life was anything but dull./
2. I began the summer with a ride into town from my best friend/
3. Jim dropped me off after a night or early morning of goodbyes;/
4. Pat our "mentor" of college graduated. *
5. While home; I worked as a roofer and pizza maker.
6. When roofing was slow I labored as a fencer and once did concrete.
7. I came home from work one afternoon and met these Irish lads, who happened to work with my step-father; T. Q.
8. My first day of work I became covered in soot and tar.
9. I had to return from work as a roofer and scrub myself clean.
10. I saw this beautiful girl Clair O'Brians date to her prom.
11. I returned home after laboring and had a fantastic evening as her date.
12. In June, June 16th to be exact, my friends took me to the beach on my birthday,
13. the only downside of it had been my pipe broke.
14. Upon my return from down-town my family threw me a surprise double kegger.*
15. met a girl I would lose my virginity to 7/7/07.*
16. Basically I worked and took my ex g. f. out to dinner, went and hung out with the Irish lads, went and spent the night at Kristene, before I returned home to work.

Best Summer Analysis	
Number of CUs (Productivity)	16 CUs
Number of Words	217 Words
Efficiency	13.6 Words/CU
Global Coherence	3
Local Coherence	1
	Indicated by an asterisk (*)

Appendix E

November 17, 2011

Cassie Fuller
Communication Disorders and Sciences

Thank you for submitting the research protocol titled, "Treatment of Written Discourse after Traumatic Brain Injury" for review by the Eastern Illinois University Institutional Review Board (IRB). The IRB has approved this research protocol following an expedited review procedure. IRB review has determined that the protocol involves no more than minimal risk to subjects and satisfies all of the criteria for approval of research.

This protocol has been given the IRB number 11-147. You may proceed with this study from 11/17/2011 to 11/16/2012. You must submit Form E, Continuation Request, to the IRB by10/16/2012 if you wish to continue the project beyond the approval expiration date.

This approval is valid only for the research activities, timeline, and subjects described in the above named protocol. IRB policy requires that any changes to this protocol be reported to, and approved by, the IRB before being implemented. You are also required to inform the IRB immediately of any problems encountered that could adversely affect the health or welfare of the subjects in this study. Please contact me, or the Compliance Coordinator at 581-8576, in the event of an emergency. All correspondence should be sent to:

Institutional Review Board
c/o Office of Research and Sponsored Programs
Telephone: 581-8576
Fax: 217-581-7181
Email: eiuirb@www.eiu.edu

Upon completion of your research project, please submit Form G, Completion of Research Activities, to the IRB, c/o the Office of Research and Sponsored Programs.

Thank you for your assistance, and the best of success with your research.

Robert Chesnut, Chairperson
Institutional Review Board
Telephone: 581-2125
Email: rwchesnut@eiu.edu